Washington State Department of Transportation

Memorandum

June 26, 2009

TO: K. Wahigorski/M. Andreini
NCR

FROM: T. M. Allen/D. V. Jenkins
E&EP Geotechnical Division, 47365

SUBJECT: US97, C7663
Blewett Pass Emergency Repair – Stage 3
Retaining Wall Replacment MP 169.5

The Region requested assistance in preparing retaining recommendations for replacement of a failed 3 tier rock filled gabion basket wall. Severe scour from flooding of Tronsen Creek in January 2009 caused the failure. The request for this assistance was addressed in a memorandum from Roseburg to Cuthbertson transmitted on 4/9/09. As a result of this request, a site visit was conducted in April and a field exploration plan was implemented.

The analyses, conclusions and recommendations contained in this memorandum are based on one test boring completed in the immediate vicinity of the failed gabion wall. The conditions encountered within the test boring are assumed to be representative of the subsurface conditions along the wall profile. If during construction, the conditions change, we recommend contacting our office for further evaluation.

Soil and Groundwater Conditions

One test boring was advanced in the shoulder of the south bound lane. In general, the site soils consist of 34 ft of loose to medium dense silty sand and poorly graded sand with gravel underlain by very dense poorly graded sand with silt and gravel. The test boring did not encounter obstructions. Cobbles and very large boulders were observed in the existing Tronsen Creek channel. A copy of the boring log and lab test data is attached to this memorandum.

Groundwater below the existing roadway prism is expected to be at or slightly higher than the stream level within Tronsen Creek. Wet soil samples were obtained approximately 15 ft below the highway grade which is consistent with the stream elevation at the time of the exploration.

Retaining Wall Recommendations

We are recommending replacing the failed gabion wall with a welded wire face structural earth wall. Hilfiker and Tensar provide welded wire face walls that are pre-approved for use on WSDOT projects. Hilfiker uses a galvanized welded steel wire mat for internal reinforcement and Tensar uses geogrid internal reinforcement.

We recommend using the following soil parameters in the general special provisions:

Soil Properties	Wall Backfill	Retained Soil	Foundation Soil
Unit Weight (pcf)	130	120	125
Friction Angle (degrees)	38°	34°	32°
Cohesion (psf)	0	0	0
		AASHTO Load Group I	AASHTO Load Group VII
Allowable Bearing Capacity		4 ksf	8 ksf
Affective Peak Ground Acceleration Coefficient (g), (Factored =As/2)		0	0.13

The minimum depth of embedment for the welded wire face wall should be greater of the following (embedment depth is measured from the adjoining finished grade at the wall face to the bottom level of internal reinforcement):

- Frost depth based on county requirements.
- Wall should be embedded a minimum of 2 ft below scour elevation or at scour elevation provided adequate scour protection at the wall face is provided. Scour protection should be evaluated by the Region hydraulics engineer.
- 2.0 ft on sloping ground (4H:1V or flatter)
- Foreslope in front of wall
  -Horizontal: H/20
  -3H to 1V: H/10
  -2.5H to 1V: H/8
  -2H:1V: H/7
  -1.5H:1V: H/5

A 4 ft wide minimum horizontal bench is required in front of the wall along the entire wall length.

Analyses was conducted to evaluate the minimum reinforcement length to satisfy global and bearing capacity requirements. Both static and seismic cases were evaluated. In order to meet the minimum safety factors for global stability, the required total reinforcement length is 0.7H or 8 ft which ever is higher.

Wall settlement is expected to be less than 2 inches. Post construction settlement should be negligible.

Construction Considerations

In order to build the replacement retaining wall, temporary shoring will be required to maintain two lanes of traffic during construction. Temporary shoring would likely consist of either drilled H-piles and lagging or driven steel sheet piles. Because of the expected design height of the shoring wall lateral support using ground anchors will likely be required. The contractor is advised that obstructions such as cobbles and boulders may be present. Although such obstructions were not encountered in the exploratory test boring, cobbles and large boulders were observed within the existing stream channel. Very dense soils were encountered at depth which could affect the installation of driven steel sheet piles. Drilled in wall anchorages/tiebacks, may require the use of casing.

During wall erection it is expected that Tronsen Creek will be confined in a temporary culvert through the construction site. The replacement wall will be founded at or below scour depth which is several feet below the existing stream bed elevation. The contractor is advised that groundwater seepage should be expected within the excavation. Sumps with pumps may be necessary to de-water the excavation.

Summary of Geotechnical Conditions

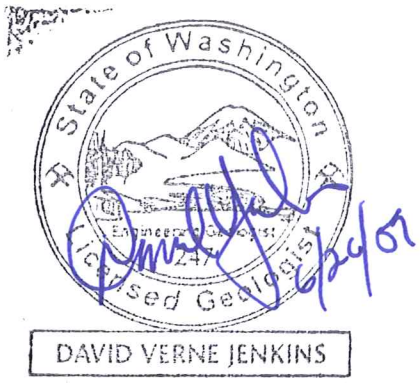
Attached with this memorandum is a summary of geotechnical conditions. The summary of geotechnical conditions should be included in the contract plans.

TMA:dvj

Attachment

cc: J. Roseburg, NCR

Prepared by:
David Jenkins, L.E.G.
Project Development and Consultant Manager



Technical review by:
JIM CUTHBERTSON, P.E., L.E.G.
Chief Foundation Engineer

Agency Approving Authority:
TONY M. ALLEN, P.E.
State Geotechnical Engineer

SUMMARY OF GEOTECHNICAL CONDITIONS

The following is a summary of geotechnical conditions for this project. This summary constitutes an advisory specification and is intended to assist prospective bidders during bidding and construction.

Site and Subsurface Conditions

The replacement retaining wall is located on US97 in the vicinity of milepost 169.5. An existing 3 tier rock filled gabion basket wall failed (overturned) as a result of severe scour from flooding of Tronsen Creek in December 2008. Subsurface investigation for design of the replacement wall consisted of advancing one testing in the shoulder of the south bound climbing lane.

In general, the site soils consist of 34 ft of loose to medium dense silty sand and poorly graded sand with gravel underlain by very dense poorly graded sand with silt and gravel. The test boring did not encounter obstructions. Cobbles and very large boulders were observed in the existing Tronsen Creek channel.

Groundwater

Groundwater below the existing roadway prism is expected to be at or slightly higher than the stream level with Tronsen Creek. Wet soil samples were obtained approximately 15 ft below the highway grade which is consistent with the stream elevation at the time of the exploration.

Construction Considerations

In order to build the replacement retaining wall, temporary shoring will be required to maintain two lanes of traffic during construction. Temporary shoring would likely consist of either drilled H-piles and lagging or driven steel sheet piles. Because of the expected design height of the shoring wall lateral support using ground anchors will likely be required. The contractor is advised that obstructions such as cobbles and boulders may be present. Although such obstructions were not encountered in the exploratory test boring, cobbles and large boulders were observed within the existing stream channel. Very dense soils were encountered at depth which could affect the installation of driven steel sheet piles. Drilled in wall anchorage/tiebacks, may require the use of casing.

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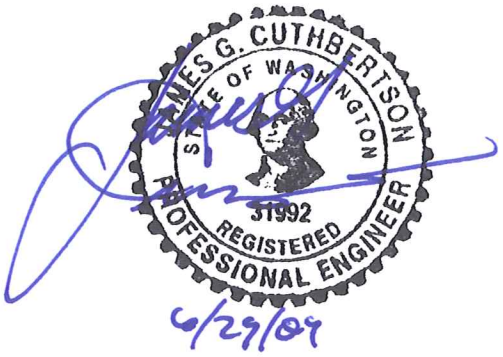
Available Geotechnical Reports and Information

The following soils information and data were used in the preparation of the foundation recommendations. This report is available at the Project Engineers office or online at:

http://www.wsdot.wa.gov/biz/contaa/wsdotpro/GEO-TECH%20REPORTS/DEFAULT.HTM

Jenkins, David, US97, Blewett Pass Emergency Repair Stage 3, MP 169.5 Retaining Wall Replacement, Geotechnical Recommendations, June 2009.



Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-32576

HOLE No. H-1-09

Sheet 1 of 3

Job No. C-7663 SR 97 Elevation 1459.8 ft

Project Blewett Pass Emergency Repair-Stage 3 Driller Sanders, Ryan Lic# 2935T

Site Address SR 97 at MP 169.5 Inspector Johnson, Vince #2532

Start April 28, 2009 Completion April 28, 2009 Well ID# Equipment CME 55 (9C1-1) - AH

Station 10+62 Offset 24' LT Hole Dia (inches) 4 Method Wet Rotary

Northing Easting Collected by HQ Geotech Division Datum

County Chelan Subsection NW1/4 of NE1/4 Section 20 Range 18 EWM Township 22

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
5	1455.0			10 9 7 (16)		D-1		Silty SAND with gravel, medium dense, dark yellowish brown, moist, homogenous, HCl not tested, Trace wood debris, trace gravel.. Length Recovered:1 ft. Length Retained:1 ft.		
10	1450.0			6 5 4 (9)		D-2	GS MC	SM, MC=18% Silty SAND with gravel, loose, dark yellowish brown to dark greenish gray, moist, stratified, HCl not tested, Sample wet to moist. Trace gravel, trace hair roots. Length Recovered:0.8 ft. Length Retained:0.8 ft.		
15	1445.0			17 9 5 (14)		D-3		Silty SAND with gravel, medium dense, brown, wet, stratified, HCl not tested, Top 0.3 wood debris. Length Recovered:0.8 ft. Length Retained:0.8 ft.		
								100% lost circulation.		
20	1440.0			15 12		D-4		Poorly graded SAND with silt and gravel, medium dense, brown, wet, homogenous, HCl not tested, Drilling		

SOILA C-7663 SR-97 BLEWETT PASS EMERGENCY REPAIR - STAGE-3.GPJ SOIL.GDT 6/12/09

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-32576

HOLE No. H-1-09

Job No. C-7663 SR 97 Elevation 1459.8 ft

Sheet 2 of 3

Project Blewett Pass Emergency Repair-Stage 3

Driller Sanders, Ryan Lic# 2935T

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
				10 (22)				indicates gravels at 16.5'.. Length Recovered:0.7 ft. Length Retained:0.7 ft.		
25	1435			0 1 4 (5)		D-5	GS MC	SM, MC=28% Silty SAND, loose, dark yellowish brown, wet, homogenous, HCl not tested, Trace gravel.. Length Recovered:1.5 ft. Length Retained:1.5 ft.		
30	1430			12 11 10 (21)		D-6	GS MC	SP-SM, MC=13% Poorly graded SAND with silt and gravel, medium dense, dark yellowish brown, moist, homogenous, HCl not tested. Length Recovered:0.9 ft. Length Retained:0.9 ft.		
35	1425			21 21 22 (43)		D-7		Poorly graded SAND with silt and gravel, dense, dark yellowish brown, moist, stratified, HCl not tested. Length Recovered:1 ft. Length Retained:1 ft.		
40	1420			24 50 (74)		D-8		Poorly graded SAND with silt and gravel, very dense, dark yellowish brown, moist, homogenous, HCl not tested. Length Recovered:0.5 ft. Length Retained:0.5 ft.		
45	1415							End of test hole boring at 40 ft below ground elevation. This is a summary Log of Test Boring. Soil/Rock descriptions are derived from visual field identifications and laboratory test data. Note: REF = SPT Refusal Bail/Recharge test: Hole Diameter: 4 Depth of boring during bail test: 40' Depth of casing during bail test: 37'		

SOILA C-7663 SR-97 BLEWETT PASS EMERGENCY REPAIR - STAGE 3.GPJ SOIL.GDT 6/12/09

Washington State Department of Transportation

LOG OF TEST BORING

Start Card S-32576

HOLE No. H-1-09

Job No. C-7663 SR 97 Elevation 1459.8 ft

Sheet 3 of 3

Project Blewett Pass Emergency Repair-Stage 3

Driller Sanders, Ryan Lic# 2935T

Depth (ft)	Elevation (ft)	Profile	Field SPT (N) / Moisture Content / RQD (20 40 60 80)	Blows/6" (N) and/or RQD FF	Sample Type	Sample No. (Tube No.)	Lab Tests	Description of Material	Groundwater	Instrument
50	1410							Bailed bore hole water level to 18.7' Recharge after 1 minutes :18.5' Recharge after 2 minutes :18.5'		
55	1405									
60	1400									
65	1395									
70	1390									

SOILA C-7663 SR-97 BLEWETT PASS EMERGENCY REPAIR - STAGE 3.GPJ SOIL.GDT 6/12/09

Job No. **C-7663** Date **May 11, 2009**

Hole No. **H-1-09** Sheet **1** of **1**

Project **Blewett Pass Emergency Repair-Stage 3**

Laboratory Summary

Washington State Department of Transportation

	Depth (ft)	Depth (m)	Sample No.	USCS	Color	Description	MC%	LL	PL	PI
●	9.0	2.74	D-2	SM	See Boring Log	SILTY SAND with GRAVEL	18			
⊠	24.0	7.32	D-5	SM	See Boring Log	SILTY SAND	28			
▲	29.0	8.84	D-6	SP-SM	See Boring Log	POORLY GRADED SAND with SILT and GRAVEL	13			

GRADATION FRACTIONS

	%Gravel	%Sand	%Fines	Cc	Cu
●	29.3	50.2	20.5		
⊠	7.1	70.3	22.6		
▲	35.9	52.5	11.6	0.5	58.4

GRADATION VALUES

	D60	D50	D30	D20	D10
●	1.483	0.60	0.17		
⊠	0.286	0.23	0.11		
▲	3.599	1.76	0.33	0.19